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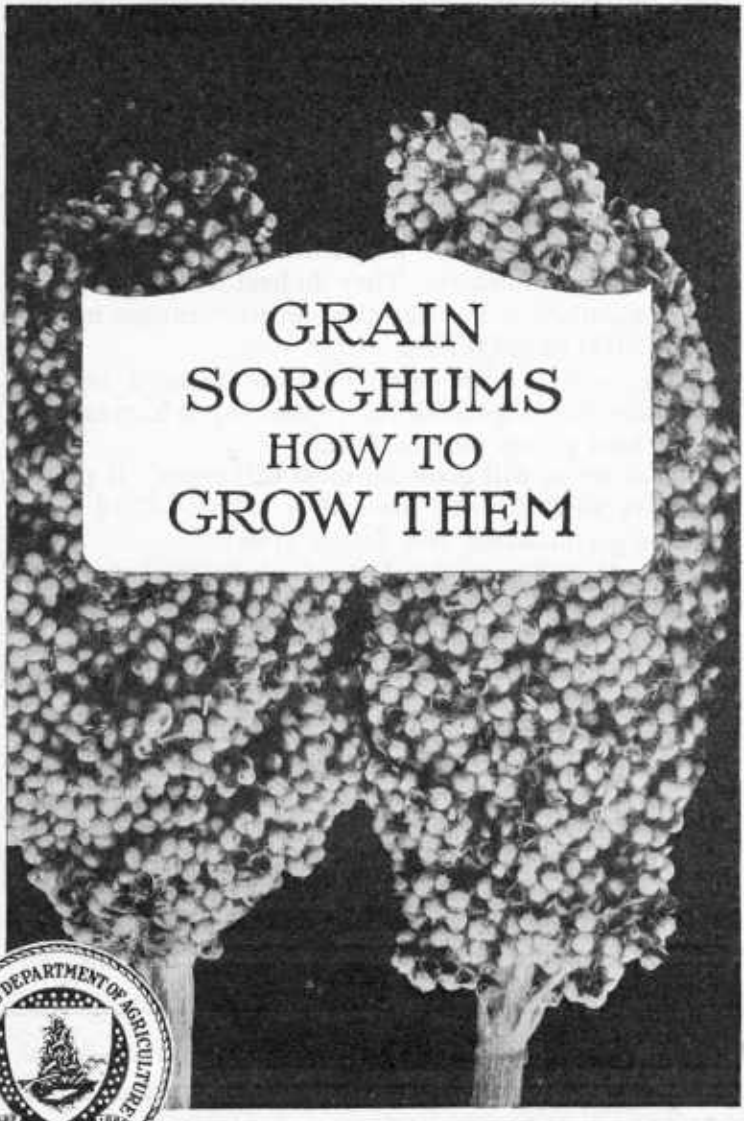

GRAIN SORGHUMS HOW TO GROW THEM

THE GRAIN-SORGHUM CROP increased from approximately 2,000,000 acres in 1903 to 5,085,000 acres in 1924. The average acre yield varies from about 12 bushels in poor seasons to more than twice that quantity in favorable seasons.

The more important grain sorghums are included in two groups of varieties, the kafir group and the milo-durra group. Dwarf and early varieties in both groups are best for the higher and drier districts. The use of good seed of adapted varieties, a well-prepared seed bed, clean cultivation, and the right method of handling after harvest will increase the yield and quality of the grain.

The milos and feterita ripen in 90 to 110 days, which adapts them to short seasons, high elevations, and low rainfall. The kafirs are not so early and require more moisture. They do best when the rainfall is about 25 inches and the elevation ranges up to about 2,000 or 2,500 feet.

Pure seed is important. Select the seed heads from the standing stalks before the crop is harvested, so the best plants may be found.

These crops will grow on most soil types. It pays to delay sowing until the soil is warm. Cold soil injures germination and delays growth.

From 2 to 3 pounds of good, clean seed are required to sow an acre. On the average, 10 to 12 inches of row space to the plant in rows $3\frac{1}{2}$ feet apart is best for the milos and feterita and 14 to 16 inches for the kafirs.

Clean cultivation is essential for best results. Kill the weeds and keep the surface soil loose. Harvest the crop when it is ripe. Dry or cure the heads properly before threshing and adjust the thresher so that the grain will not be cracked. The grain should be clean and dry before it is stored in bulk; otherwise it will get out of condition quickly. While in storage it should be watched for signs of heating.

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GRAIN SORGHUMS: HOW TO GROW THEM.

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CONTENTS.

IMPORTANCE OF THE GRAIN SORGHUMS.

THE ACREAGE devoted to the grain-sorghum crop shows a substantial increase in the last 20 years. In 1903 this crop occupied about 2,000,000 acres, which was increased to more than 6,000,000 acres in 1918. Since 1918 the sorghum acreage has been more stable, the average for the five years from 1919 to 1924, inclusive, being 5,136,000 acres. When an extensive abandonment of fall-sown wheat occurs in the grain-sorghum area, the sorghum acreage increases, as in 1918, and more recently in 1923, when 5,775,000 acres of the crop were grown.

The yield varies considerably in different years. In 1915 an estimated total production of 114,460,000 bushels was obtained from 4,153,000 acres, or an average of 27.6 bushels to the acre. In 1917 the production from 5,153,000 acres was estimated at 61,409,000 bushels, or an average of only 11.9 bushels to the acre. The average acre yield for the 10 years from 1915 to 1924, inclusive, was 19.9 bushels and for the 5 years from 1919 to 1924, inclusive, 21.9 bushels.

The variation in yield is due partly to seasonal conditions and partly to the methods employed in growing the crop. The high average acre yields in 1915 and in 1919 were produced under favorable conditions. In such seasons poor varieties as well as poor methods of growing the crop make fairly good yields. In unfavorable seasons, like those of 1916, 1917, and 1918, poor varieties and

poor methods of growing the crop result in failure. This accounts in a very large measure for the low average yields in those years. In very unfavorable seasons the best adapted varieties grown by the best methods often succeed while others fail. Earliness and dwarfness are two important factors in determining the varieties to grow in much of the grain-sorghum region. Early and dwarf varieties do better at high elevations, in short seasons, and under low rainfall than larger and later ones. Late varieties require long seasons and more moisture, though under favorable conditions they sometimes outyield the early dwarf varieties.

VARIETIES OF GRAIN SORGHUMS.

The sorghums commonly grown in this country may be divided naturally into three classes: (1) Sorgo, or saccharine sorghum; (2) grain sorghum, or nonsaccharine sorghum; and (3) broom corn. Each of these classes is made up of groups of varieties having some characteristics in common, and each class is grown for some particular purpose.

The sorgos, or saccharine sorghums, are marked by their tall stalks, which are full of sweet juice. The heads are quite variable in shape and color and usually do not produce heavy grain yields. The stalks are more valuable than the grain in this group of varieties, which are grown generally for forage and the production of sirup.

The broom corns are distinguished by their dry, pithy stalks and by their long, loose, open heads called brush. The heads, which are the important part of the crop, are used in making brooms and brushes.

The grain, or nonsaccharine sorghums, usually range in height from 3 to 6 feet. Some varieties in this class have dry, pithy stalks and short, narrow leaves. Others have broad leaves and juicy stalks, but the juice is usually slightly acid. All varieties in this class have large seed heads. The heads and kernels vary in shape, size, and color. This bulletin deals only with the more important varieties of grain sorghums.

The grain sorghums include several groups of varieties. The most important are the kafir and the milo-durra groups. Other groups of less importance are the kaoliangs and the shallus.

KAFIR GROUP.

The kafir group is marked by stout, short-jointed, leafy stalks. The leaves are broad, 12 to 16 or more in number, set close together on the lower half of the stalk but farther apart on the upper portion. The stalks are juicy, but the juice usually is not sweet like that of

the sorgo, or forage, group. However, one variety (Sunrise kafir) developed recently has a fairly sweet juice. The heads are cylindrical, 10 to 15 or more inches long. The ovoid seeds are of medium size and are about half covered by the short glumes or hulls. Heads of four varieties of kafir are shown in figure 1.

Six varieties of kafir are now grown commercially to some extent as grain crops in this country. These are the White, Blackhull, Dawn, Sunrise, Red, and Pink kafirs. Other varieties of less importance than these are sometimes grown in some localities.

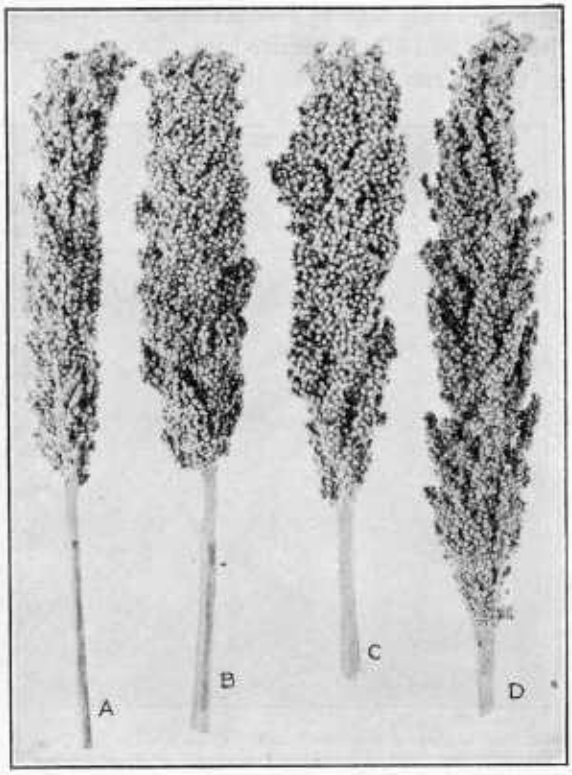

FIG. 1.—Heads of four varieties of kafir: *A*, White kafir; *B*, Guinea kafir (Guinea corn of the West Indies); *C*, Blackhull kafir; *D*, Red kafir. (About one-third natural size.)

WHITE KAFIR.

White kafir is one of two varieties of grain sorghum introduced from southeastern Africa in 1876. It is rather dwarf, from 3½ to 5 feet tall in the dry-land areas, and is the earliest of all kafir varieties. The heads are slender and the glumes and seeds are white. Its chief value is its earliness, the yield usually being low; hence this variety is not recommended, nor is it grown to any great extent now.

BLACKHULL KAFIR.

Blackhull kafir appeared in this country shortly after White kafir. The stalks are stout and contain slightly acid juice. They usually grow to a height of 5 to 6 feet in the dry-land areas, and taller elsewhere. The leaves are 12 to 16 or more in number, 2 to 3 feet long and 3 to 5 inches wide. The heads are heavy, compact, 10 to 14 inches long, with black glumes, or hulls, and white seeds. This variety requires from 115 to 140 days to mature, depending on the locality and on seasonal conditions. It is not as early as White kafir, Dawn kafir,

or Sunrise kafir, and can not be ripened successfully at as high an elevation, in as short a season, or with as light a rainfall. However, it is the leading commercial variety. A plat of Blackhull kafir is shown in figure 2.

DAWN KAFIR.

Dawn kafir is a dwarf form developed by the United States Department of Agriculture from the Blackhull variety about 10 years ago. It grows only 3 to 4½ feet tall under dry-land conditions and matures from 10 to 14 days earlier than the ordinary Blackhull kafir. A plat of this variety is shown in figure 3.

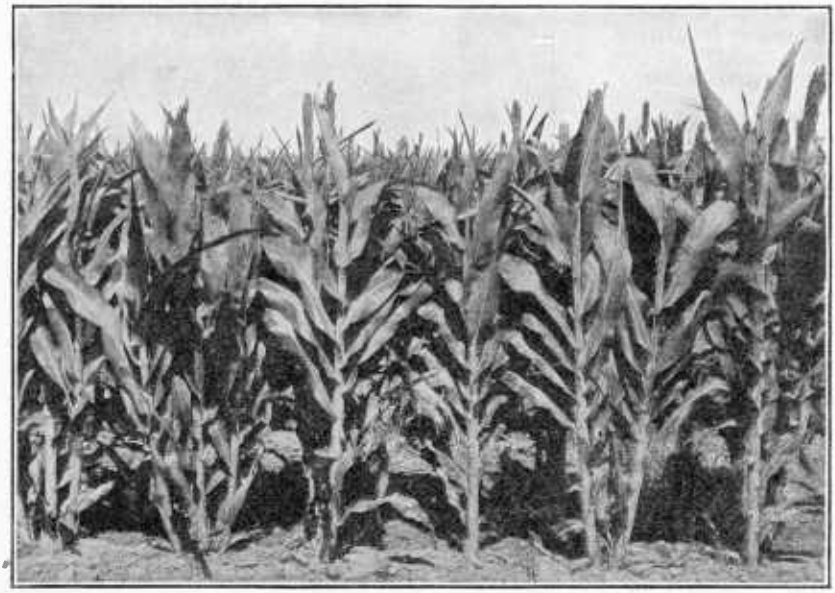

FIG. 2.—A plat of Blackhull kafir (C. I. No. 71) on the experiment farm at Dalhart, Tex., August 31, 1911. Compare the stage of development with that of the Dawn kafir in figure 3, sown on the same day in an adjacent plat.

Dwarf stature and earliness are important characteristics in a reliable grain crop in the drier sections of the Great Plains area. These factors make possible the maturing of this variety under conditions where the ordinary Blackhull kafir fails. Dawn kafir is increasing in acreage and favor with the growers each year.

SUNRISE KAFIR.

Sunrise kafir was developed at the same time and from the same source as Dawn kafir. These two varieties differ mainly in the size, height, and sugar content of the stalks. Sunrise kafir has a slender stalk, which contains sweet juice and grows 5 to 7 feet tall under dry-

land conditions. Dawn kafir has a stouter and dwarfer stalk. Plats of these varieties are shown in figure 4.

Sunrise kafir is early and is a good grain producer. The sweet, leafy stalks and abundant grain make it a good silage variety. It appears to be increasing in favor with growers who desire a grain or silage crop.

RED KAFIR.

Red kafir was introduced from Africa at the same time (1876) as White kafir. In its requirements Red kafir is quite like the Blackhull variety. The leaves are slightly narrower and the heads are

FIG. 3.—A plat of Dawn kafir (C. I. No. 340) on the experiment farm at Dalhart, Tex., August 31, 1911. Compare its earliness with that of standard Blackhull kafir (fig. 2) sown on the same day.

longer and more slender than those of the Blackhull. The seeds are red and the glumes are dark red to black.

Red kafir was formerly grown to a greater extent than at present. It has been replaced by the Blackhull variety, because that variety has a wider adaptation and the yield usually is higher.

PINK KAFIR.

Recent introductions from South Africa have brought many new kafir forms. Some of these have seeds of various shades of pink, more or less intermediate between the white-seeded and red-seeded varieties. Several of the best of these have been introduced to cul-

tivation under the name Pink kafir, but they have not become commercially important.

A Pink kafir is now grown to some extent, mostly in Kansas, which makes fair yields under average conditions. Its origin is not known, though probably it is a natural cross between White kafir and Red kafir. It was found growing in Kansas about 12 years ago. This variety is fairly early, and resembles White kafir in manner of growth. The heads are much like those of Red kafir in length and shape, but the glumes are gray and the seeds are pale red or pink.

FIG. 4.—Dawn kafir (right) and Sunrise kafir (left) in plats at the Woodward (Okla.), Field Station, September 20, 1919.

MILO-DURRA GROUP.

The common characters of the milo-durra group are slender, pithy stalks from 3 to 7 feet tall, bearing from 7 to 11 rather small leaves. The heads are large and compact, usually egg shaped, and are either erect or pendent. The glumes usually are black, but in some varieties are gray. The seeds are large, strongly flattened, either brown or white, and are one-third to one-half inclosed within the glumes.

Six varieties belonging to this group are grown commercially to some extent. These are Standard milo, Dwarf milo, White milo, Dwarf White milo, feterita, and White durra. These varieties mature in from 80 to 110 days under normal conditions in the drier sections of the southern Great Plains area. They can be grown with less moisture, in shorter seasons, and at higher altitudes than the

kafir varieties. They are therefore better adapted than those varieties to the uplands of western Kansas, western Oklahoma, and the Panhandle of Texas, where the average annual rainfall is 20 inches or less and where the elevation is 3,000 feet or more.

STANDARD MILO.

Milo was grown first in this country about 1882. It was not uniform in maturity and in height, most of the plants being tall. Standard milo is a direct descendant of the original type, reduced by systematic selection to a uniform height of from 5 to 6 feet under dry-land conditions in the southern Great Plains, where it is now grown to a large extent. This variety has 9 to 11 rather short and narrow leaves borne on a stalk which contains practically no juice. The heads are large, ovoid, and compact, and are either erect or pendent. The glumes are black and wrinkled crosswise. The large yellowish seeds are about one-third inclosed in the glumes. A typical head of milo is shown in figure 5.

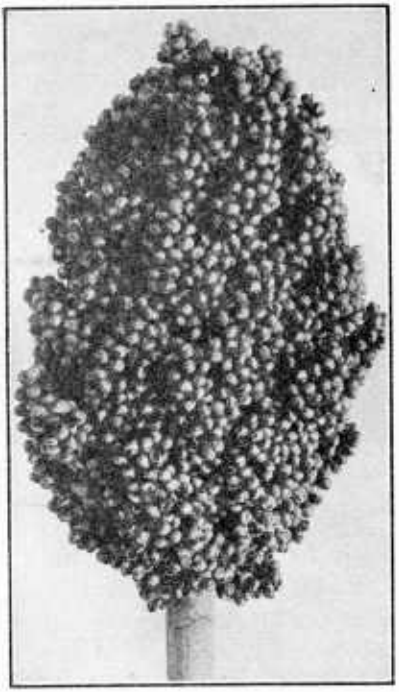

FIG. 5.—Head of milo. (About half natural size.)

DWARF MILO.

Dwarf milo closely resembles Standard milo, but grows only from 3 to 4 feet tall, depending on seasonal conditions. The comparative height of these varieties is shown in figure 6. Standard milo is from 18 inches to 2 feet taller than Dwarf milo when grown under the same conditions.

Dwarf milo makes up half or more than half of the acreage devoted to milo in this country. It usually produces a larger grain yield than the Standard variety and, because of its shorter stalks, can be harvested more satisfactorily with a grain header.

WHITE MILO.

White milo probably appeared in this country somewhat later than Standard milo. It differs from Standard milo in having white seeds, as the name indicates. The grain yields of this milo compare

favorably with those of Standard milo, but are not as large as the yields of Dwarf milo. The acreage of White milo is small and probably will remain so, as it has no advantage over Standard milo.

DWARF WHITE MILO.

Dwarf White milo bears the same relation to White milo as Dwarf milo does to Standard milo. This variety has been developed quite recently. A small acreage has been grown in the past few years, and some very good yields have been reported.

FETERITA.

Feterita is a native of Africa and is a leading variety in part of the Sudan region. It was introduced into this country in 1906. In

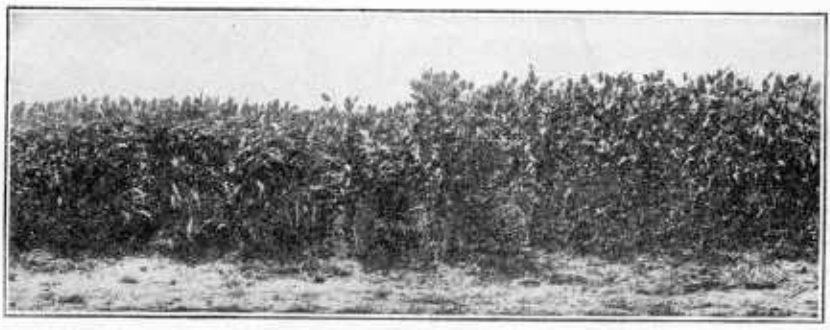

FIG. 6.—Milo (right) and Dwarf milo (left) in plats at the Amarillo (Tex.) Cereal Field Station, August 30, 1911.

habit feterita resembles milo, though the heads are always erect. Feterita heads are more elongated and the seeds are bluish white and slightly larger than those of milo. A plat of this variety is shown in figure 7.

Feterita requires about the same climatic conditions as milo. It appears to be able to stand a little more drought, but it does not respond to a plentiful supply of moisture as favorably as milo. Feterita sometimes produces a crop under drought conditions when milo practically fails. The acreage of feterita has increased to some extent in the past few years but is not nearly so large as that devoted to the milos.

WHITE DURRA.

White durra was among the first grain-sorghum varieties grown to any extent in this country. It was known as "White Egyptian corn" in California and as "Jerusalem corn" in Kansas and adjacent States. It has been almost entirely replaced by the more productive

varieties of kafir, milo, and feterita. California is practically the only State where White durra is grown now.

White durra has a slender stalk, which grows from 5 to 7 feet tall and bears from seven to nine small leaves. The stalk is dry, which, with the scanty foliage, makes it of little value for forage. The heads are large, egg shaped or oblong, and either erect or pendent. The glumes are greenish white and hairy, and cover about half of the large, strongly flattened, white seeds. When ripe the seeds shatter freely.

White durra is early, ripening in from 80 to 100 days, which makes its growth possible in short seasons. It is not naturally a heavy yielder under favorable conditions and, with its objectionable habit of

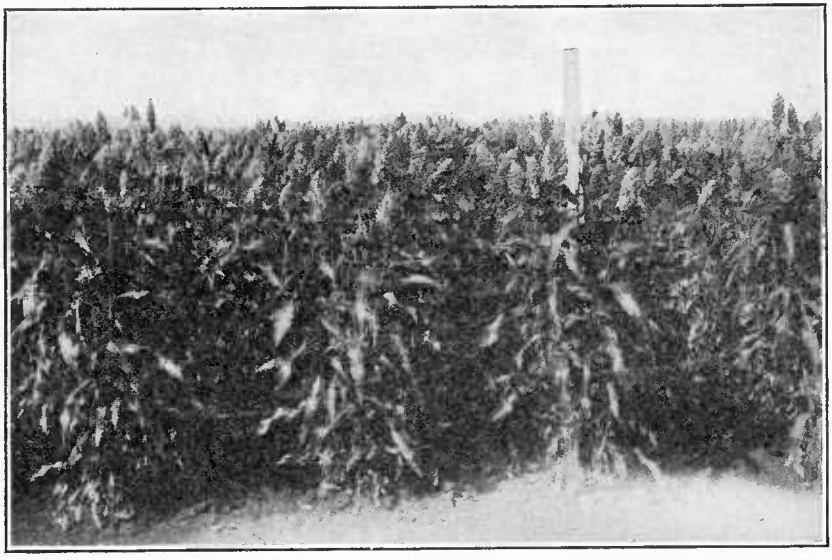

FIG. 7.—A plat of feterita (C. I. No. 182) at the Amarillo (Tex.) Cereal Field Station, September 28, 1915; yield, 55.5 bushels per acre.

shattering, is not a good variety to grow under conditions where more productive varieties are likely to mature.

OTHER GRAIN SORGHUMS.

The kaoliangs are natives of China and Manchuria, where they are cultivated extensively. Many varieties have been tested in this country, but so far none has proved of much value under our conditions. The kaoliangs have pithy stalks and short, narrow leaves, which make them of low fodder value. Their average grain yield is not as high as that from the better adapted varieties of kafir, milo, and feterita under the conditions obtaining in the southern Great Plains area. Some varieties are early and may be the means of adding

another grain crop in regions north of where kafir, milo, and feterita will mature.

Shallu is a late-maturing variety which has been widely advertised under several names and somewhat misrepresented. Under favorable conditions and a long growing season shallu makes fair yields. It is not a good variety to grow in most of the grain-sorghum belt. The yields are best in the extreme southern portion.

INCREASING THE YIELD AND QUALITY OF THE GRAIN.

The main steps in increasing the yield and quality of sorghum grain are as follows:

(1) Grow adapted varieties.
(2) Use pure seed of high vitality.
(3) Prepare a good seed bed.
(4) Sow the crop at the most favorable time.
(5) Sow at a uniform depth, so that all the seeds come in contact with moist soil.
(6) Use plates that will give the desired stand.
(7) Cultivate the crop well, to prevent the growth of weeds, for weeds can not grow on the land at the same time without injury to the sorghum.
(8) Harvest the crop as soon as it is ripe.
(9) Let the crop get dry before thrashing.
(10) Adjust the cylinder so that it will not crack the kernels.
(11) Use the fanning mill to screen and blow out cracked kernels and dirt.
(12) Store the clean grain in a dry well-ventilated bin or in bags.

THE VARIETY TO GROW.

Grow the variety of grain sorghum which is most likely to prove best in a series of years. No one variety will make the highest yield under all conditions. Where there is plenty of moisture and a long, warm growing season, the late-maturing Blackhull kafir usually yields more than any other variety. Under drier conditions and in shorter seasons the earlier varieties are surer and on the average outyield the later ones.

No fixed lines can be drawn showing just where each variety succeeds best. In general, the milos and feterita should be grown on the uplands, at elevations of 3,000 feet or more, and in the drier sections of the grain-sorghum belt. These varieties mature in fewer days and require less moisture than the kafirs. They usually give better results than the kafirs in localities where the average annual rainfall is 20 inches or less. The milos and feterita succeed well in southwestern Kansas, in the Panhandles of Oklahoma and Texas, in eastern Colorado, and in northeastern New Mexico. In southern Arizona and in California, where the crop is grown under irrigation, Dwarf milo usually outyields other varieties.

The kafirs are well adapted to localities which have an average annual rainfall of approximately 25 inches and an elevation up to

or slightly more than 2,500 feet. The bulk of the kafir crop should be grown east and south of the territory previously indicated for the milos and feterita. However, the kafirs do well in much of that territory in favorable seasons. The early kafirs, Dawn and Sunrise, are the best varieties to grow. The larger broad-leaved Blackhull kafir requires a longer season and more moisture than the early varieties. It should be grown farther east and south, at lower elevations and where the rainfall is greater.

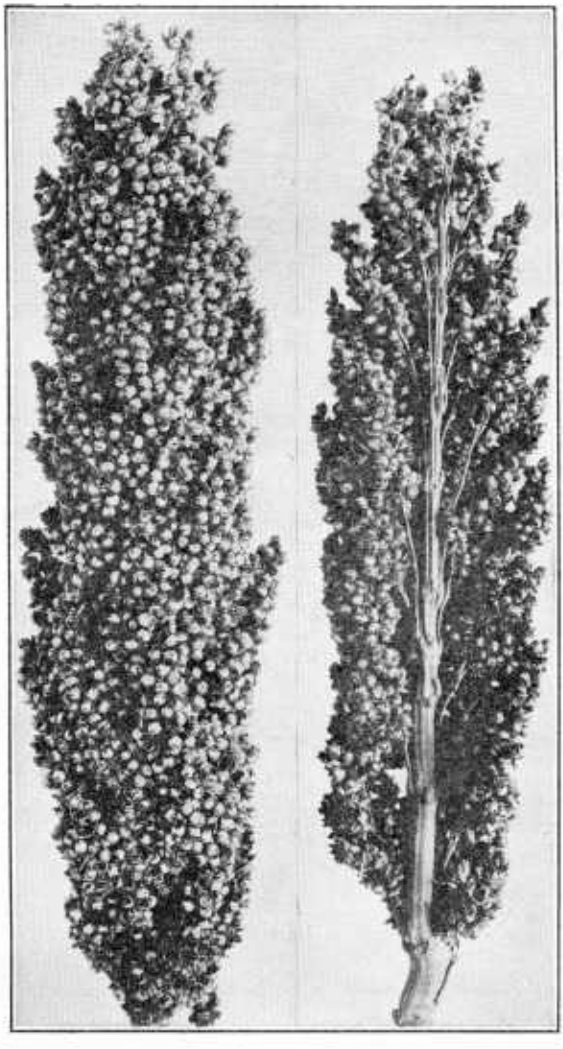

FIG. 8.—A good type of kafir head (left), showing inside construction (right).

SELECTING SEED.

Pure seed which germinates strongly is one of the chief factors in the production of large grain yields. Therefore care must be exercised in selecting the seed. This is essential not only as a means of improvement but also to prevent deterioration of the crops. Poor, off-type, low-yielding heads are always present, and the seed from such heads will be sown if the bulk grain thrashed from the entire crop is used.

The best seed obtainable should be used for sowing. From the resulting crop, seed heads should be selected for sowing the next year. Through continuous systematic selection from year to year it is possible to make substantial improvements in the uniformity of the plants and heads and to increase the yield and quality of the grain.

THE HEADS TO SELECT.

Select the heads which in size and shape, color of the glumes, and size and color of the seeds are true to the variety. Good types of kafir and milo heads are shown in figures 8 and 9. The unusually large off-type heads which always can be found in grain-sorghum fields should not be gathered for seed. These heads are from hybrids resulting from the crossing of varieties and will not breed true to type. The sorghums are open pollinated and cross readily under field conditions when two or more varieties are grown close together.

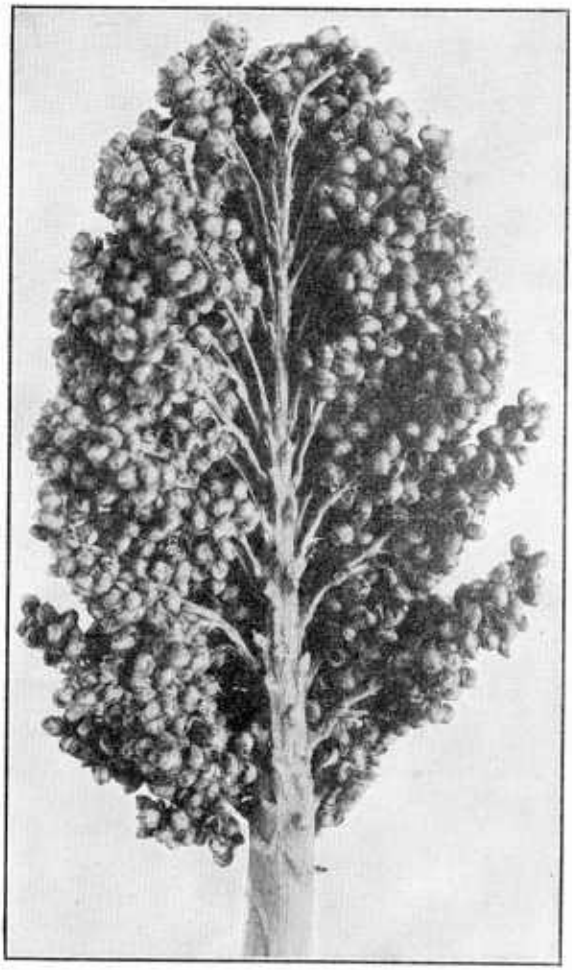

FIG. 9.—Inside construction of a typical head of milo.

Uniformity must be the watchword in making head selections if the quality of the crop is to be maintained or improved. The best type to grow should be determined and selections then made to that type. The main points to be observed in making head selections are: (1) Uniformity in height of the plants; (2) uniformity in shape and size of the heads; (3) uniformity in ripening; (4) uniformity in productiveness; and (5) in the milos and durra, uniformity in erectness of heads. In this group erect heads should be chosen in preference to pendent heads, other things being equal.

Where dwarf varieties are preferable the plants from which the heads are selected should be of a uniformly low stature, because a crop of uniform and comparatively short stalks usually makes a

better grain yield and is much easier to harvest either by hand or by machinery than a crop of tall nonuniform stalks. Neither is the crop of dwarf stature so likely to lodge as the tall one if windstorms occur.

WHEN TO MAKE HEAD SELECTIONS.

The seed heads must be selected before the main crop is harvested. This work should be done at or before the time when half of the crop is ripe, as then the early plants can be seen easily. When the crop is fully ripe the early plants can not be distinguished from the late ones. Earliness often is the deciding factor between success and failure of the crop in much of the grain-sorghum belt and should not be overlooked or neglected in making the selections.

Seed heads may be selected before they are ripe enough to harvest. In that case it is necessary to mark them in some way, so they can be found when harvest time comes. A tag or piece of binder twine tied to the base of the head makes a good marker. The twine alone is effective and inexpensive. Marking is not necessary if selection is delayed until the seed is ripe enough to harvest. Then the heads should be cut as they are selected. About 4 inches of stem should be cut off with the head. A burlap bag hung from the shoulder by a strap is the simplest container in which to place the heads as they are gathered.

STORING THE SEED HEADS.

Proper care of the seed heads after harvest is important in maintaining the vitality of the seed. The heads must be stored in a dry well-ventilated place where they are protected from damage by rats, mice, and birds. They will heat if piled before they are dry; hence they should be hung up as gathered. String them on baling wire or a cord and hang them from the ceiling or rafters of a granary or shed. The wire can be pushed through the stem and the ends twisted together after a number of heads have been put on. Cord can be substituted for the wire if a sacking needle is used to run it through the stems. About 50 heads make a bunch of convenient size to handle. Heads stored for the winter are shown in figure 10. The danger of injury by rats and mice is lessened if the bunches are suspended from the ceiling rather than hung against the walls of the building. If birds can get into the building the bunches of heads should be protected with old bags or papers.

PREPARING THE SEED FOR SOWING.

The seed heads should be carefully thrashed and the seed thoroughly cleaned and tested for germination. Seed of all varieties

except the milos and feterita should be treated for smut before it is sown. The milos and feterita so far have proved immune from attack by smut.

THRASHING THE SEED HEADS.

The seed heads may be thrashed either by hand or by machine in late winter or in early spring before the rush of spring work begins. The quantity of seed each farmer will need is in most cases so small that the use of a thrashing machine is not desirable.

A good way of thrashing by hand is to put the heads into a stout bag, tie the mouth, lay the bag on the floor or bench, and beat it with a stick. The bag should not be filled too full and it should be turned over occasionally, so that all the heads will be beaten. For the best results, not more than about 50 heads should be put into a 2-bushel bag at one time. Where large numbers of heads are to be thrashed, more rapid progress can be made by using a large tarpaulin instead of a bag. This can be laid on the floor and the heads piled on until just room enough is left to bring the four corners of the tarpaulin together and tie them securely. Then a flail instead of a stick can be used to beat out the seed. Care must be taken to prevent cracking the seeds. The percentage of cracked seeds usually is much smaller when thrashing is done by hand than where a machine is used.

FIG. 10.—Seed heads of grain sorghums tied in bunches and stored for the winter.

All the chaff, sticks, dirt, and cracked and immature kernels should be screened or blown out by a fanning mill. If no fanning mill is convenient, winnow the seed in the wind.

Hulls and cracked or immature kernels mixed with the good seed make uniform stands impossible.

SEED TREATMENT FOR KERNEL SMUT.

The smut treatment is as follows:[1]

Mix 1 pound of commercial formaldehyde with 30 gallons of water. Put the seed in sacks and immerse the sacks in this solution for 1 hour, stirring it occasionally. Then take the sacks out and set them to drain. Spread the seed out on a clean floor or canvas. Be sure that all of the sacks, the barn floor, and the canvas used in handling the grain after treatment are cleaned either with boiling water or with a strong formaldehyde solution. The seed will be infected again if any untreated smut spores touch it. When the seed is sufficiently dry after treatment, it may be sown.

The same solution may also be used as a spray, in which case the seed to be treated should be spread out on a clean floor or canvas and sprinkled with the solution. It must be shoveled over frequently until all of the seeds are wet. It may then be shoveled into a pile, covered with a clean canvas or sacking to keep in the fumes, and left over night. In the morning it should be spread out to dry. Seed treated in this way will be free from smut. The immersion method is more thorough, but it is not as convenient as the sprinkling method.

GROWING THE CROP.

Grain sorghums will grow on almost any soil, ranging in type from light sandy soils to heavy clay loams. A maximum yield of 88 bushels to the acre has been produced on the sandy soil at the Big Springs Field Station, Big Springs, Tex. Similar yields have been recorded at the Amarillo Cereal Field Station, Amarillo, Tex., where the soil is a heavy chocolate loam.

Rich soils will produce higher yields than poor soils, other things being equal. However, most of the soils in the region where grain sorghums are important are productive enough to give good yields. Moisture and its distribution are more often the determining factors in sorghum production than the soil. With good seed, proper cultivation, and moisture sufficient for normal plant growth, good yields may be obtained on either light or heavy soils.

PREPARING THE SEED BED.

The work necessary to prepare a good seed bed depends largely upon the kind and condition of the soil. Light soils usually require less work than heavy soils. The seed bed should be uniform. All the large clods must be pulverized and the surface soil well worked, so that no large holes or air pockets are left, but the surface should not be worked into a fine dust mulch. Heavy soils puddle and bake after rains and light soils blow more readily if the surface is too fine.

[1] Freeman, Edward M., and Umberger, Harry J. C. The smuts of sorghums. U. S. Dept. of Agr., Bureau of Plant Industry Cir. 8, p. 6–7. 1908.

PLOWING.

Fall plowing gives better results on the average than spring plowing. Their relative values depend largely on the amount of moisture in the soil and on the winter precipitation. If plowing is done early in the fall, before the weeds have used the available moisture in the soil, and the winter precipitation is normal or above, then fall plowing has a decided advantage over spring plowing. Plowing destroys the weeds and helps to conserve the moisture already in the soil, while plowed land left rough over winter will catch the snow and hold more moisture than unplowed land. For the best results fall plowing on old land should be at a depth of 6 to 7 inches. Late in the spring shallow plowing is sometimes best if moisture in the surface soil is lacking and the crop is to be sown immediately after plowing is done. The seed may then be sown in contact with moist soil without being covered too deeply.

The first breaking of sod should be at a depth of about 3 inches.

HARROWING.

Harrowing puts the plowed land in condition for sowing the crop. How much is necessary to make a good, rather compact seed bed depends on the condition of the soil. When plowing is left rough over winter, usually one disking early in the spring and once over with a spike-tooth harrow just before the crop is sown are sufficient. The disk will pulverize the large clods, destroy weeds, and compact the soil, and the harrow will smooth the surface and destroy the small weeds which start after the land is disked. More work is necessary under unfavorable conditions, but the surface should not be worked into a fine dust.

LISTING.

Listing may take the place of plowing and is preferred by some farmers because it is a more rapid method of preparing the land. Listing prevents soil blowing to a greater extent than plowing and should be practiced on soils which blow. When listing is done in the early fall late weeds will be killed. The lister furrows will help prevent soil blowing and will catch the snow during the winter, thus saving moisture that otherwise often is lost. Because of the rapidity with which land can be prepared by listing and the benefits in saving moisture and preventing soil blowing, the practice is very general throughout the grain-sorghum area.

When listing is done in the fall or winter the best seed bed can be prepared by cutting down the ridges with a disk harrow in the spring and relisting the land at seeding time. The disking may be omitted and the ridges or middles split with the lister. This method gives good results under favorable conditions and avoids the expense of disking the land.

SOWING THE CROP.

HOW TO SOW.

The grain sorghums are either surface grown or listed (figs. 11 and 12) in rows spaced about 3½ feet apart. A corn drill (corn planter) or lister drill fitted with sorghum plates is used for sowing the crop. A better stand usually is obtained from surface sowing than from listing. The plants also grow better in the early part of the season, because the seed is placed near the surface where the soil is warmer and more favorable to germination and growth than it is at the bottom of the lister furrow. Under certain conditions the listed crop has advantages over the one which is surface sown. Listing helps to prevent soil blowing and the deep furrows protect the young plants from being whipped by the winds or cut to pieces by

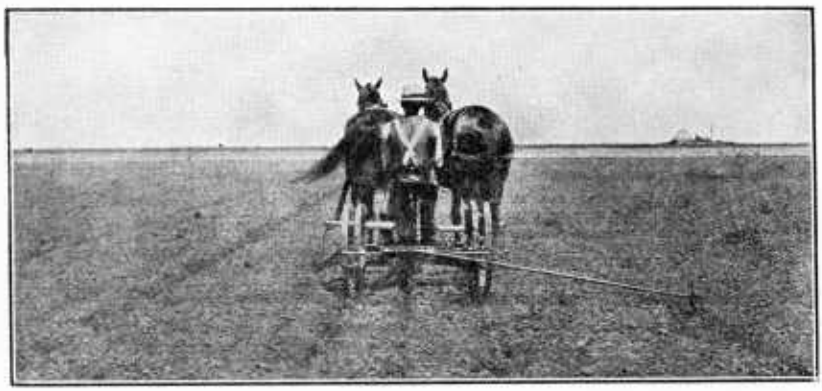

FIG. 11.—A 2-row surface drill in operation at Amarillo, Tex.

moving particles of soil. The method to be used in any given locality depends largely on the soil type and on the weather conditions. Listing is very generally practiced in the drier portions of Kansas, Oklahoma, and Texas.

WHEN TO SOW.

The grain sorghums are of subtropical origin and therefore grow best where the temperatures are high. The seeds will not germinate well nor will the plants make normal growth in cold soils. For the best results seeding must not be done too early in the spring. A good time to sow in any given locality is from 10 days to 2 weeks later than the average date for planting corn there.

The best time to sow the sorghums in the Panhandle of Texas and adjacent territory is from about May 15 to June 10. If sowing is delayed much later the cool nights in September retard ripening and early frosts may catch the crop before it matures. South of the

Panhandle section sowing should start earlier. In the San Antonio (Tex.) section the crop should be sown early in March. This region has a long growing period, but the early-sown crop is most likely to escape damage from the sorghum midge, which usually does not appear in large numbers until June. By that time the early crop has passed the flowering stage, which is the period when the midge does its injury.

At Woodward, Okla., the time to sow the crop ranges from May 1 to June 15. In seasons that open early, so the soil is warm by May 1, early sowing gives the best results. In other seasons with late, wet springs, later sowing is desirable.

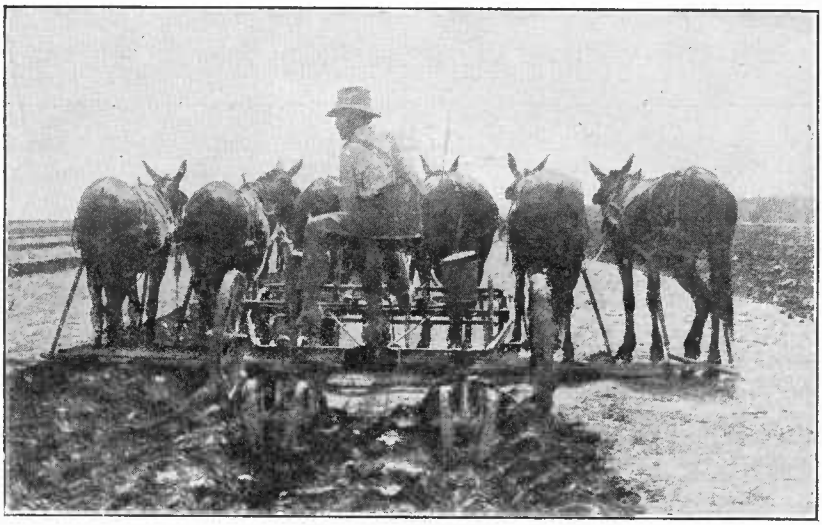

FIG. 12.—A 2-row lister-drill in operation at Hays, Kans.

HOW MUCH SEED TO SOW.

No one stand or rate will produce the highest yield under all seasonal conditions. Thick stands yield higher than thin ones in favorable seasons, but in dry seasons thin stands are best. The best average yield from Dwarf milo in the 5-year period from 1914 to 1918, inclusive, at the Amarillo Cereal Field Station, Amarillo, Tex., resulted from a stand of one plant to every 10 to 12 inches of row space in rows 3½ feet apart. Dawn kafir yielded best from a stand of one plant to 14 to 16 inches of row space during the same period. Similar results have been obtained at other stations.

To get the stand desired it is necessary to sow at a heavier rate because all the seed will not germinate under field conditions, though it may have shown 100 per cent germination in the laboratory or the home test. From 2 to 3 pounds of clean viable seed ordi-

narily is sufficient to sow 1 acre when the rows are spaced 3½ feet apart. Heavier seeding may be necessary to obtain a stand under unfavorable conditions.

CULTIVATING THE CROP.

Cultivation should be begun early and repeated frequently enough to destroy weeds and keep the surface soil loose. The sorghum plants grow slowly when young and are easily injured by weeds. If weeds are allowed to grow in large numbers serious damage to the crop is sure to result. As much or more water is required to produce a large weed than a sorghum plant. When the available moisture is limited, as it usually is in the grain-sorghum region, that used by weeds is at the expense of the sorghum crop. This results in reduced yields or even in a total failure.

The spike-tooth harrow is a satisfactory implement to use for the first and often for the second cultivation of surface-sown sorghum. If the surface soil crusts or bakes so that the emergence of the plants is made difficult or if the weed seeds on the surface are germinating rapidly, then the first harrowing should be given before the plants are up and the second one before they are large enough to be worked satisfactorily with the shovel cultivator. On soils free from weed seeds and under favorable conditions for the plants to emerge, the first harrowing may be delayed until after the crop is up and the second harrowing may be omitted. The harrow teeth must be slanted backward at an angle which will prevent them from pulling out the seeds or young plants. The field should then be cultivated often enough to destroy all weeds and to keep the surface soil in a loose, mellow condition, so that it will take up moisture readily. The loss of moisture by run-off and from weed growth after the plants are too large to be cultivated will then be reduced to the minimum.

The listed crop can be best cultivated with lister cultivators. Some of these cultivators are equipped with disks, some with shovels, and others with both disks and shovels. The disks and shovels are adjustable, so that the soil can be thrown either to or from the plants. At the first cultivation the soil is thrown from the small plants, in order to prevent covering them. Later, as the plants grow taller, the dirt gradually is thrown toward the plants, filling the furrows and leveling the ridges at the same time. After the ridges are leveled, the ordinary shovel cultivator must be used if further cultivation is necessary.

HARVESTING.

Three methods of harvesting the grain-sorghum crop are in common use. These are (1) heading by hand, (2) heading with a grain header, and (3) harvesting the whole plant with a row binder. By the first and second methods the stalks are left standing in the field,

where they may be used for pasture or turned under as manure. In the third method both stalks and heads are harvested and the whole crop may be fed or the grain threshed later.

CURING.

The heads usually contain too much moisture at harvest time to be threshed or put immediately into large bulk without danger of heating. In good weather the heads may be spread in a thin layer on grass and left to cure, which will take about 10 days. Then the heads may be threshed, or they can be put into large piles or stacks and threshed later. These stacks should be covered with some material which will turn water and so protect the heads from heavy rains. A better and safer way to handle the heads, however, and one which requires but little added expense, is to provide well-ventilated bins or cribs where they can be stored as harvested. This saves one handling and prevents rain injury. The cribs should be not more than 6 feet wide, about 8 or 10 feet high, and as long as is necessary to hold the crop.

A simple method of constructing a crib is to set posts 6 feet apart in two parallel rows also 6 feet apart. A 2 by 4 scantling or a 6-inch board should then be spiked on the outside at the top of the posts. This will help to hold the posts in place and will support the roof. At least two pieces of the same material should be spiked to each pair of posts crosswise of the crib. One should be placed about 2 feet above the ground and another about 3 feet below the top of the posts. After the crib is filled and the mass of heads has settled, a small space will be left under each cross brace, which will permit free circulation of air through the crib. Thus, the braces not only hold the crib together but aid in the ventilation. The sides of the crib should be left as open as practicable. Woven-wire fencing makes satisfactory siding for this purpose. It should be stretched tightly on the outside of the posts and stapled securely to them. The mesh in the fencing must be small enough to keep the heads from falling through. Any heavy fencing with a small mesh will do. The roof may be made of any convenient material that will turn water.

The crop harvested with a row binder is cured best by setting the bundles in shocks in the field, where they may stand until dry. The shocks may contain from 12 to 18 bundles with safety, depending on the condition of the crop and the weather at harvest time. A well-matured crop can be put into larger shocks than one not so mature without danger of damage from heating or molding. The bundles should be set close together and all leaning slightly to the center. The finished shock will then shed most of the water from heavy rains.

THRASHING.

The grain sorghums are thrashed with the same machine that is used for threshing the small grains. By adjusting the cylinder and concaves and regulating the speed to suit the nature of the crop,

satisfactory results may be obtained. About half of the concave teeth should be removed and the speed of the cylinder reduced to about two-thirds that required for thrashing wheat. A large part of the seeds will be cracked if these adjustments are not made. The kernels are larger and softer than those of wheat and will not stand as hard thrashing.

If the crop was cured in the bundles it may be thrashed (1) by first cutting the head from the bundles with an ax or large knife and thrashing only the heads, (2) by holding the bundles against the cylinder until the heads are thrashed, and (3) by putting the whole bundles through the machine. The latter is possible only when the stalks are short and small.

STORING THE GRAIN.

The grain may be stored either in bins or bags. It should be free from foreign material and cracked kernels and should be dry when stored in large bulk or it will heat and spoil. Dirt, chaff, or cracked seeds will fill the spaces between whole kernels and keep out the air. In warm weather the grain will heat in a short time if it contains a high percentage of moisture. The grain should be watched while in storage, and if heating starts it should be stirred so the air can pass through and cool it off. This is done at grain elevators by running the grain from one bin to another. More time and labor are required on the farm where the bins are not equipped with elevators. A safe way there is to equip the bins with ventilators or to store the grain in bags. The bags can be put in a dry place where the air will have free circulation around them. Grain entirely too moist to store in bins may be stored in this way with safety, and it will dry while in storage.

A simple ventilator for use in farm bins was devised by George Bishop and described by him in an issue of the Oklahoma Farm Journal during the fall of 1915. The following description is adapted from that source:

> This ventilator (fig. 13) is a long, narrow box of wood and wire screen, extending from side to side of the bin and opening to the outer air. To make it, take two pieces of 1-inch board (*a*) 4 inches wide and as long as the bin is wide. Place these on edge about 4 inches apart. Take cleats or strips of wood (*b*) 1 inch thick and 1½ or 2 inches wide, and mortise them into the upper edges of the boards (*a*), flush with the surface and about 1 foot apart.
>
> Take galvanized-wire screen, either ordinary fly screen or similar screen with a mesh too small to permit kafir seeds to pass through. Cover the ends of the ventilator with pieces of screen (*c*) cut large enough to lap over on to the sides for an inch or so and tack tightly. Then cut the screen into strips wide enough (about 19 or 20 inches) to go completely around the ventilator box. Fasten all the screen (*d*) tightly with tacks or small staples.
>
> The ventilator now has two wooden sides and a wire-screen top, bottom, and ends. Across the bottom nail several cleats (*e*) or strips of 1-inch lumber. These will lift the ventilator an inch from the floor and permit air to circulate freely in the lowermost layer of grain.

The ventilators should be placed 3 or 4 feet apart on the floor of the bin. The ends must fit into or set flush against holes cut in the outer walls of the bins. The wire screen over the ends of the ventilators

prevents the entrance of rats or mice. Cold air circulating through the ventilator passes up through the grain and cools it if heating starts. In deep bins a row of ventilators placed upright through the center may be desirable. These should be placed with the lower end

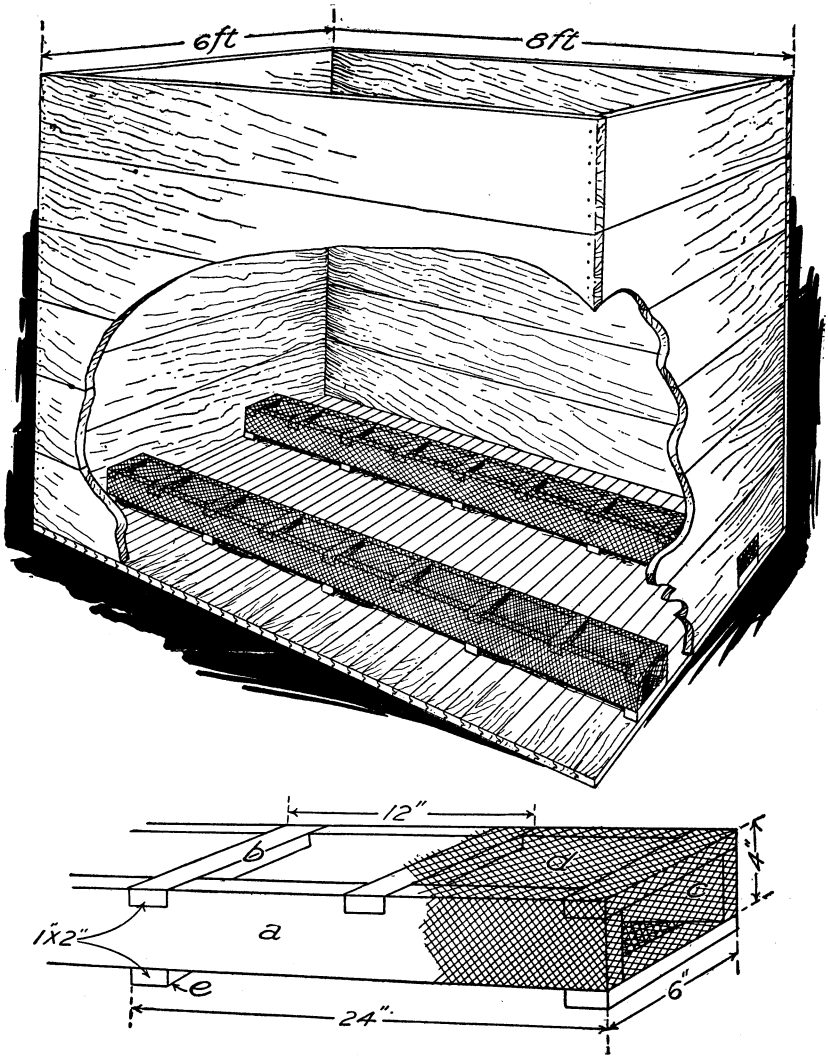

FIG. 13.—Ventilator for a bin containing sorghum grain. Upper figure, view of two ventilators in position on floor of bin, showing opening in side of bin. Lower figure, detailed structure and dimensions: *a*, side of ventilator; *b*, cleat mortised in upper edge of *a*; *c*, wire screen over end of ventilator; *d*, wire screen covering top and bottom, also sides; *e*, cleat on bottom to raise ventilator from floor.

resting on the horizontal ventilator, thus giving a free circulation of cold air through the mass of grain. When the bin is not in use for storing sorghum grain the ventilators may be removed and the bin used for other purposes.

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